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CHAPTER TWO

ENVIRONMENTAL CONDITIONS



“Nature, to be commanded, must be obeyed.”

--*Francis Bacon, Novum Organum*--

The impact...

of people living in community has presented challenges since the beginning of permanent settlements. The development of cities is the most obvious current-day shaper of the environment. Indianapolis has had to live within the fabric of the natural environment and has had to live with the choices of its forebears, such as the filling of swamps to create buildable land and the construction of a combined sewer system to provide the sanitary disposal of waste. Indianapolis will be faced with additional choices in the future, since projections indicate that between 91 and 93 percent of Marion County will be developed by the year 2025. Our descendants will live with the choices we make today.

Through the course of the town hall meetings and the issue committee process, it was evident that environmental considerations will become more critical to land use decisions, as available land is consumed through development. It is important, therefore, to understand the environmental constraints our community will face, so that rational, timely, and comprehensive decisions can be made.

Climate

Indianapolis' climate features cool northern air masses alternating with southern tropical air masses to bring significant weather changes within days and create variability to the seasons. The area is also on the fringe of the climatic influence associated with the Great Lakes. The Great Lakes act as a giant heat sink and humidifier, moderating the temperatures of the surrounding land and increasing the moisture content of the air throughout the year.

Temperatures have ranged between a low of -27 degrees to a high of 107 degrees. Average temperatures, however, are more moderate and are shown in Table One. Generally, temperatures are higher than 90 degrees on an average of sixteen days per year and are below freezing an average of thirty-seven days per year. First freezing has occurred as early as September 30, but averages around October 16. The last freeze has occurred as late as May 27, but averages around April 22.



Annual precipitation is evenly distributed throughout the year as shown in Table One. Spring and early summer rains usually exceed winter precipitation, with the least amount of precipitation occurring in February. Average annual snowfall is twenty inches, with nearly half of that total falling in January and February. Thunderstorms occur on approximately 44 days per year.

Table One: Weather Information

Month	Temperature (degrees F)		Precipitation		
	Average Minimum	Average Maximum	Average Total Inches	Inches of Snowfall	Days of Snowcover
January	17.2	33.7	2.32	8.2	9
February	20.9	38.3	2.46	7.8	7
March	31.9	50.9	3.79	3.2	3
April	41.5	63.3	3.70	0.0	0.5
May	51.7	73.8	4.00	0.0	0
June	61.0	82.7	3.49	0.0	0
July	65.2	85.5	4.47	0.0	0
August	62.8	83.6	3.64	0.0	0
September	55.6	77.6	2.87	0.0	0
October	43.5	65.8	2.63	0.4	0
November	34.1	51.9	3.23	1.6	1
December	23.2	38.5	3.34	5.8	6

Geology, Topography and Soils

Indianapolis is located near the geographic center of Indiana. It is comprised of approximately 257,888 acres and is located in the lower third of a large, flat natural region called the Tipton Till Plain.

Landscapes are very dynamic and evolve over time, through a continuous process of erosion and deposition. The topography and soils in Indianapolis were formed through the influences of three glacial periods, the last of which covered the area approximately 20,000 years ago. As the glaciers retreated from Indianapolis, the area was scoured to a flat plain with a gently rolling surface.



Low relief and few abrupt changes characterize the topography of the area, which varies between approximately 900 and 650 feet above sea level. Areas that demonstrate distinctive slopes and topography do so due to the actions of numerous rivers, streams and other tributaries formed from the melting and retreating glacial ice. Many ravine topographical features were formed from the post-glacial era to modern times as a result of erosion cutting through a cap of fine clay silt or wind-blown dust that covered post glacial formations. The deep valleys of the White River and Fall Creek are prominent topographical features, which now serve as floodplains for modern streams.

Glacial deposits range from 15 to 300 feet in thickness and cover the surface of Indianapolis with clay-rich (till) and alluvial parent materials. These parent materials are the primary source of a soil's characteristics; however, the climate, topography, the length of time the forces of soil formation have acted on the soil material, and plant and animal life on and in the soil are also key determinates. The preponderance of soils outside the current urbanized area are rated severe for septic tank absorption fields and foundations. Ratings for septic absorption fields depend upon features such as a seasonal high water table, slow permeability and surface water ponding. Overcoming these limitations requires both sanitary sewer service and associated surface water removal.

In addition to the glacial till, major outwash deposits of sand and gravel occurred, primarily in the White River valley, but also in the smaller Buck, Eagle and Fall Creek stream valleys. Both the till and outwash rest atop rugged sedimentary bedrock, which generally consists of overlapping, gently tilted strata of sandstone, shale, and limestone.

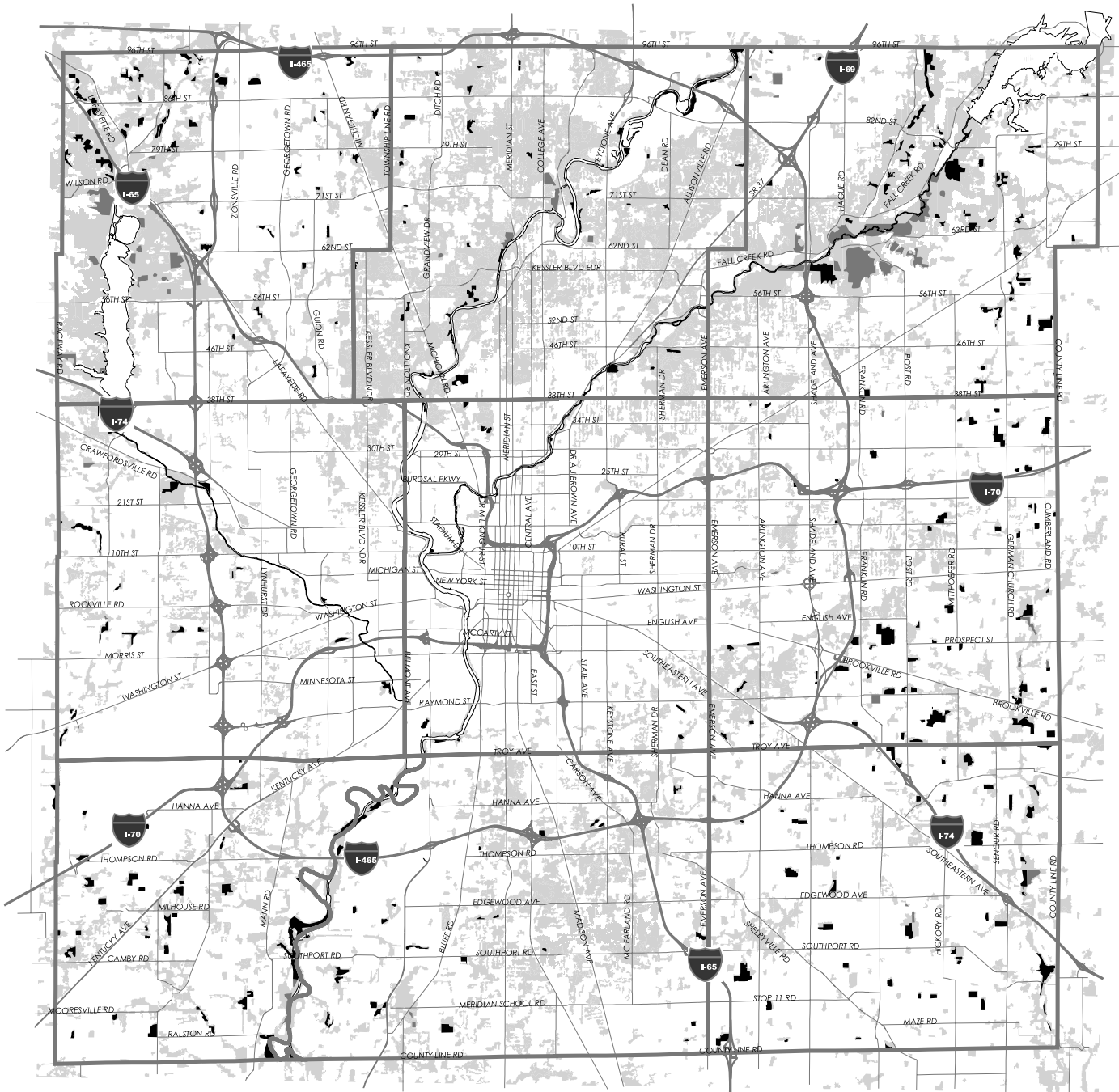
The glacial outwash and sedimentary bedrock provide the natural resources of sand, gravel and crushed limestone. An estimated 439 million tons of these materials are commercially accessible. Approximately 15 million tons of these products are consumed in central Indiana each year.

Urban Forest

The sum of all native, naturalized and exotic shrubs and trees within the city comprise the urban forest. While Indianapolis possesses areas of significant woodlands and woodlots, there has been a large decline in urban trees over the last fifteen years. Urban development combined with a shorter life span has meant that urban trees have been disappearing faster than they are replaced. Trees removed for development fail to be replaced and only about one in four trees lost on public property are replaced.



In addition to the well-documented aesthetic benefits and wildlife habitats ascribed to woodlands, a thriving urban forest can also enhance the general welfare of the community. Trees absorb gaseous pollutants, such as carbon dioxide, ozone, sulfur dioxide and nitrogen dioxide. These substances are then recycled and store



Tree Canopy Map

- Tree Canopy
- Parks and Natural Woodland
- Natural Woodland



0.8 0 0.8 1.6 Miles

in a durable form. Trees reduce stormwater runoff and moderate peak flows as the root system absorbs water and the canopy reduces the force with which water hits the ground. Through shading, an urban canopy can lower peak energy demands during the summer months. Urban tree cover also absorbs noise and prevents sediment erosion into waterways.

Water Resources

Marion County is drained by numerous rivers, creeks, brooks, runs and ditches, which all eventually flow into the White River (although Buck Creek takes a circuitous route via the Big Blue River). Natural characteristics of major waterways include relatively stable flow rates, low sediment and nitrogen loads, sustained and adequate dissolved oxygen levels, meandering channels, natural plant communities and corresponding native plant and animal diversity. Natural rivers and streams sustain a viable water supply, aid healthy riparian wildlife and support recreational opportunities.

There are no natural lakes or ponds in Marion County; however, engineered reservoirs are common. The two largest are Geist and Eagle Creek Reservoirs on the north side of the City; however, numerous small basins have been constructed to temporarily hold stormwater runoff and release it at a controlled rate into the public drainage systems.

Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. These wetlands provide habitat for improving stream quality, treating stormwater and providing habitat requirements. Many of the springs, seeps and seasonal ponds are not on wetland maps and escape attention. All known remaining wetland areas in Marion County have moderate to severe cultural impact, such as damage from invading, non-native vegetation and chemical runoff.

Watersheds

A watershed is an area of land that drains water, sediment and dissolved materials to a common receiving body or outlet. The term is not restricted to surface water runoff and includes interactions with subsurface water. Watersheds vary from the largest river basins to just acres or less in size.

Environmental protection programs in the United States have successfully improved water quality during the last quarter century, yet many challenges remain. The most recent national water quality inventory shows that, as of 1994, nearly 40 percent of surveyed waters in the US remain too polluted for fishing, swimming and other uses. The leading causes of impairment found in the survey include silt, sewage, disease-causing bacteria, fertilizer, toxic metals, oil and grease.

In Indianapolis, the management of water resources is done with a watershed approach. The watershed approach is a coordinating framework for environmental management that focuses public and private sector efforts to address the highest priority problems within hydrologically-defined geographic areas, taking into consideration both ground and surface water flow.

Stormwater and Flood Control

Stormwater management, drinking water treatment, and wastewater treatment are the three basic water-related services provided to Indianapolis residents. Indianapolis has begun new programs to comply with new federal stormwater quality regulations, protect drinking water wells (wellhead protection), reduce problems caused by combined sewer overflows (CSOs), and improve efficiency of wastewater treatment.

Flooding of Indianapolis' waterways is primarily of two types: heavy rains/snow melts or short high intensity storms. Flooding is not limited to any particular season or time of year. Water runoff is natural, but pavement and other impervious surfaces intensify it. How the runoff from hard surfaces is managed can either prevent or create flooding.

A variety of methods have been used to mitigate the effects of the flooding throughout the community. Those methods include the implementation and adoption of state and local building codes and a secondary zoning based on Federally designated special flood hazard areas. Additionally, a series of levees, channel improvements, realignments and reservoirs have been constructed to minimize flood damages.

Although the City has completed drainage improvement projects over the years, it has yet to implement a comprehensive, citywide stormwater drainage improvement plan. City council members, city staff, and the Mayor's Action Center annually receive hundreds of calls from property owners who are concerned about poor drainage, deferred maintenance, and nuisance flooding.

In early 1998, the City of Indianapolis committed to developing a Countywide Stormwater Master Plan. The plan was initiated by proposals in the City-County Council to fund stormwater improvements.

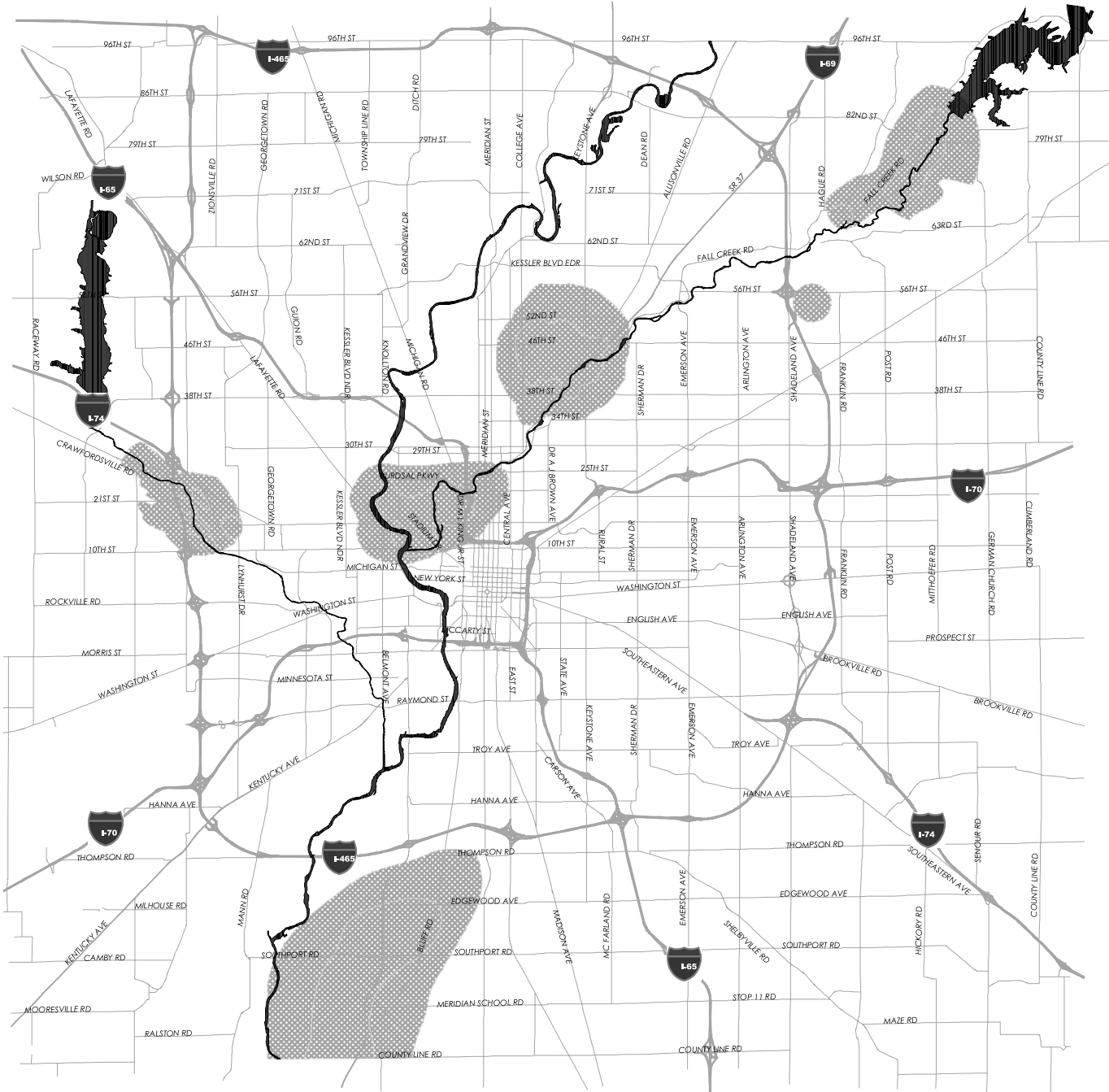
Wellfield protection

Most of Indianapolis's drinking water comes from surface sources such as White River and Fall Creek. However, while the supply of surface water remains the same, the demand for water is increasing, so a growing proportion of the County's drinking water is being taken from the groundwater by wells. The areas where the wells are located are referred to as wellfields.

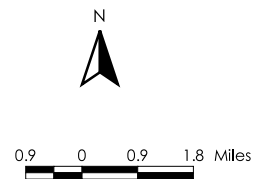
Wellfields are part of the larger aquifers that lie under Marion County. Aquifers are porous underground water-bearing strata.

A safe, efficient groundwater supply system requires monitoring, treatment and prevention of contamination. To protect the underground drinking water supply, the Wellfield Protection Zoning Ordinance was adopted in 1997. This ordinance created Wellfield Protection Zoning





Wellfield Protection Area Map



Districts that are delineated by the time a drop of water takes to travel from the ground's surface through the ground to a well intake. The districts are divided into W-1 (one year time of travel) and W-5 (five year time of travel) zones. The ordinance provides for additional review of permits for businesses that wish to locate in wellfields and that use products that may contaminate the groundwater. These businesses are typically asked to make accommodations for the potential spills of contaminants.

Combined Sewer Overflows

More than 100 years ago, Indianapolis installed a combined sewer system to carry both sewage and stormwater away from homes, businesses, and streets. This system carried wastewater directly to several of the city's rivers and streams, a standard practice at the time. As the city grew, the system created too much waste for the waterways to handle on their own. Federal laws required Indianapolis and other cities to build wastewater treatment plants to treat the wastewater before it was discharged into the river. Indianapolis now has two wastewater treatment plants, the Belmont Advanced Wastewater Treatment (AWT) plant, built in 1925, and the Southport AWT, built in the mid-1960s.

Indianapolis' first sewer system carried both sewage and rainwater in the same pipe, making it a "combined" system. During dry weather, a combined sewer system adequately performs its job of carrying sewage to treatment plants. When it rains or snows melt, however, the water entering a combined system can exceed the capacity of the sewer pipes or treatment plants. When this happens, combined sewer systems are designed to overflow directly into nearby streams or rivers, so the sewers do not back up into homes and basements. This concept is called a combined sewer overflow.

The problems with combined sewer systems were recognized in Indianapolis as early as 1944, when the Preliminary Master Plan for the City indicated:

"It is apparent that when heavy rainfall or flood conditions occur, the sewers in some neighborhoods are surcharged, becoming temporarily ineffective, and the disposal plant is unable to process the volume of incoming sewage...

Early action should be initiated with regard to a thorough checkup and analysis of the City's sewage disposal. A considerable period of time will be required to do this and plans for actual constructive work also require time. This project is of the highest priority in the interest of the health and safety of the whole community, and should be in blueprint form as early as possible to be carried out as soon as material, labor and funds can be provided. It seems no more fitting than the capital city should set an example in conclusive elimination of pollution of natural water resources and in an effective sewage disposal."

Combined sewer overflows are a major cause of water pollution in Indianapolis. Combined sewer overflows carry raw sewage, disease-causing bacteria and viruses, industrial pollutants, oil and grease, and other pollutants into rivers and streams. These pollutants can elevate bacteria levels and reduce oxygen in the water, creating water conditions harmful to fish and humans. Fish kills can hit popular species such as bass and bluegill and make it hard

for them to survive in Indianapolis. Our rivers contain viruses and disease-causing bacteria such as E. coli, which endanger anyone who comes in contact with the water. Combined sewer overflows also create unpleasant odors and floating sewage and debris. This can drive homebuyers away from surrounding neighborhoods and lower the quality of life for those living near the waterways.

The capital costs to fix the combined sewer overflows could cost Indianapolis \$840 million to \$1.3 billion – by far the largest environmental cost we face. Operation and maintenance costs over a 20-year period could add \$110 million to \$160 million, depending on the final alternatives selected.

Ozone and Particulate Emissions

While the city of Indianapolis provides a high quality of life, that quality continues to be threatened by the dangers of air pollution. In 1970 Congress passed the Clean Air Act with the intent of making the preservation of air quality a national priority. The United States Environmental Protection Agency (EPA) has used this authority to establish a wide variety of standards and programs in order to protect public health, the environment, and the quality of life from the adverse impacts of air pollution.

Air pollution can result from many various sources. Emissions from automobiles, refineries, and factories rise up into the ozone layer and eventually lead to the creation of smog. At the same time, fine particles from trucks, buses, and power plants that are released into the air enhance the mass and density of the smog. As the city of Indianapolis experiences new development, the factors that contribute to air pollution increase as well.

National Ambient Air Quality Standards (NAAQS) are set by the EPA in order to protect public health and welfare. Based on data monitored by the EPA between 1994 and 1996, Indianapolis Metropolitan Area, which includes Marion and the surrounding counties, is a potential 8-hour ozone non-attainment area.

Areas that are designated as non-attainment must submit air quality plans to the EPA. These plans are known as State Implementation Plans (SIPs) and they are supposed to show how standards will be attained. Areas failing to meet this requirement must then face Clean Air Act required sanctions and other penalties such as a loss of transportation funds.

Non-attainment areas also face the possibility of economic impacts on the community. Additional controls on small businesses and industry would not only make it more difficult for existing companies to function, but it could also make the area less attractive for new ones as well.

